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SeaWiFS identifies dust sources in the Namib Desert

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Mineral dust sources were identified in Sea-viewing Wide Field-of-view Sensor (SeaWiFS) images along the south-west coast of Africa. Up to 150 dust plumes were observed over a 3 year period, and these are linked to sources that are either salt pans or dry river beds in the Namib Desert. This demonstrates that dust supply is maintained by fluvial landforms and associated hydrology. This paper highlights the need to look in more detail at source areas around the globe, as this will further our understanding of dust-production processes.

1. Introduction

Much has been learned about the global distribution of mineral dust aerosols using the total ozone mapping spectrometer (TOMS) (Prospero 2002). The world's major dust plumes originate from topographic lows across North Africa, the Middle East and Asia. It has been suggested that much of this dust is derived from flood sediments deposited during the recent and wetter geological past of the Pleistocene (last 1.8 million years). However, TOMS is not able to detect dust below 1000 m and, with the exception of Etosha Pan, does not capture the numerous smaller plumes outlined in this study or smaller sources around the globe for that matter. As TOMS does not depict the Earth surface, the location of dust sources can only be interpreted on the basis of proximity rather than actual visual identification. In this study, we are using remote sensing to strengthen the connection between visible plumes of mineral dust and their precise source points.

We are building on a recent study that used mainly handheld Space Shuttle photography and some earlier Skylab (1972) photos. In conjunction with weather data it was possible to determine synoptic conditions that produce mineral dust along the Namib Desert coast (Eckardt *et al.* 2001). The spatial persistence of plumes was a significant observation which we are now trying to examine by focusing on the sources of dust in this study. For this purpose, we use a 3 year sequence of SeaWiFS images which capture a large number of dust plumes that emanate from persistent points along the 2000 km long Namib Desert coast. The perspective of SeaWiFS or any other similar sensor allows one to pinpoint dust sources with a higher degree of spatial detail than has been achieved so far. SeaWiFS is aboard the OrbView-2 satellite which orbits the Earth at an altitude of 705 km in a sun-synchronous orbit.

The Namib Desert has experienced aridity for 50 million years and undergone a gradual transformation towards hyper aridity over the last 10 to 5 million years

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(Ward 1983). Today, the coastal area receives less than 20 mm of rain per annum, and as a result the Namib Desert is considered to be one of the most arid regions in the world (Lancaster *et al.* 1984). A very steep rainfall gradient persists with over 100 mm of rainfall falling on the eastern edge of the Namib Desert, 150 km from the coast, and over 200–300 mm are being recorded in the highlands at an elevation of 1500–2000 m. Dry rivers cut across the Namib Desert as linear oasis and provide a conduit for occasional surface water, ground water as well as flood sediments (Jacobsen *et al.* 1995).

4. Conclusion

The persistence of small point sources in the production of mineral dust is clearly demonstrated. TOMS has played a significant role in establishing the global distribution of dust vectors and source regions. This study uses SeaWiFS images to enhance our understanding of dust-producing landforms and strengthens the hydrological function in the production of mineral aerosols. As has been demonstrated elsewhere on a global scale, mineral dust in the Namib Desert is of natural origin and supplied by a variety of fluvial processes. Recharge of dust sources in the Namib Desert is likey to occur on shorter timescales, which is in contrast to the Pleistocene sediment accumulations that fuel the world's more important source regions. We demonstrate that remote sensing can identify dust sources and further our understanding of contemporary dust-production processes and guide us in the targeting of ground-based studies.